Alternative and Renewable Fuel and Vehicle Technology Program

FINAL PROJECT REPORT

COALINGA HYDROGEN STATION

FirstElement Fuel

Prepared for: California Energy Commission

Prepared by: FirstElement Fuel, Inc.

AUGUST 2016

CEC-600-2016-001

Prepared by:

Primary Author(s):
Tim Brown
Patti Kohler

FirstElement Fuel, Inc.
5151 California Ave., Suite 220
Irvine, CA 92617
www.firstelementfuel.com

Agreement Number: ARV-14-008

Prepared for:

California Energy Commission

Phil Cazel
Agreement Manager

John Butler
Office Manager
Zero-Emission Vehicle and Infrastructure Office

John Y. Kato
Deputy Director
FUELS AND TRANSPORTATION DIVISION

Robert P. Oglesby
Executive Director

ACKNOWLEDGEMENTS

The construction of the Coalinga hydrogen refueling station has been possible only because of the substantial efforts and funds provided by a number of stakeholders. FirstElement Fuel graciously thanks Toyota for its vision and fortitude;, Air Products and Chemicals Inc., Black & Veatch, and Aliantel for bringing the project together; Tyson Eckerle for helping push the lease over the goal line; and, of course, Jean Baronas, Phil Cazel, Jim McKinney, Commissioner Janea Scott, and many others at the California Energy Commission for tremendous, sustained confidence in clean, alternative transportation.

PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP). The statute authorizes the California Energy Commission to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the ARFVTP through January 1, 2024, and specifies that the Energy Commission allocate up to $20 million per year (or up to 20 percent of each fiscal year's funds) for hydrogen station development until at least 100 stations are operational.

The ARFVTP has an annual budget of about $100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and non-road vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

The Energy Commission issued PON-13-607 to provide funding opportunities under the ARFVTP for high-performance hydrogen retail refueling stations. To be eligible for funding under PON-13-607, the projects must also be consistent with the Energy Commission's ARFVT *Investment Plan*, updated annually. In response to PON-13-607, the recipient submitted an application that was proposed for funding in the Energy Commission's notice of proposed awards May 1, 2014, and the agreement was executed as ARV-14-008 on July 22, 2014.

ABSTRACT

FirstElement Fuel designed, engineered, permitted, constructed, and made operational a hydrogen refueling station at 24505 West Dorris Avenue, Coalinga, California. FirstElement Fuel plans to own and operate the hydrogen refueling station until at least 2025. The station consists of a concrete reinforced block compound that encloses hydrogen storage, compression, and cooling equipment; a dispenser with two fueling hoses; a customer payment interface; a canopy; and a dedicated concrete fueling position for fuel cell vehicle drivers.

Keywords: California Energy Commission, Coalinga, FirstElement Fuel, Inc., fuel cell vehicles, Harris Ranch, hydrogen infrastructure, hydrogen refueling station

Please use the following citation for this report:

Brown, Tim. (FirstElement Fuel, Inc.). 2016. ***Coalinga Hydrogen Station.*** California Energy Commission. Publication Number: CEC-600-2016-001.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

Hydrogen fuel cell electric vehicles and hydrogen refueling stations are expected to play key roles in California as the State transitions to lower-carbon and zero-emission vehicle technologies for light-duty passenger vehicles, transit buses, and truck transport fleets. Numerous government regulations and policy actions identify fuel cell electric vehicles as a vehicle technology that will be available to meet the California Air Resources Board's zero-emission vehicle regulation and the Governor's goal of 1.5 million zero-emission vehicles by 2025. More specific actions to bring fuel cell electric vehicles to California markets are specified in the Governor's *Zero Emission Vehicle Action Plan*.

Hydrogen fuel cell electric drive technology offers tremendous potential for the light-duty passenger vehicle market and medium- and heavy-duty truck and bus markets. Fuel cell electric vehicle passenger vehicles can drive more than 300 miles on a tank of hydrogen and can be refueled in 3 to 4 minutes the way gasoline passenger vehicles are fueled. They have zero tailpipe emissions, while the carbon footprint of these vehicles is nearly the same as plug-in electric vehicles. The technology can be readily scaled up for sport utility vehicles, family passenger vans, pickup trucks, urban package and beverage delivery trucks, and even heavy-duty trucks and buses. Most auto industry analysts and agencies view fuel cell electric drive technology as a complement to battery electric drive technologies rather than as a competing technology. Both battery and fuel cell electric vehicle technologies will be needed in California to achieve the zero-emission-vehicle deployment goals.

In contrast to battery electric and plug-in hybrid electric vehicles that can be charged at home, fuel cell electric vehicles require a new network of refueling stations that dispense pressurized hydrogen for consumer use. This has meant that the auto industry and station development industry have had to develop two new technologies in parallel: hydrogen refueling infrastructure and hydrogen fuel cell electric vehicles (FCEVs). Fuel cell electric vehicles cannot be widely marketed and sold to consumers without a minimum network of refueling stations available.

Assembly Bill 8 (AB 8, Perea, Chapter 401, Statutes of 2013) reauthorized the original Assembly Bill 118 funding program (Núñez, Chapter 750, Statutes of 2007) and created new legal requirements for the California Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program. The bill directs the Energy Commission to allocate up to $20 million per year, or up to 20 percent of each fiscal year's available funding, to develop hydrogen refueling stations "until there are at least 100 publicly available hydrogen-fueling stations in operation in California" (Health and Safety Code 43018.9[e][1]).

The California Energy Commission contributed $1,451,000 of the total $2,159,000 cost to design, engineer, permit, construct, and make the station operational.

The site selected for this project is 24505 West Dorris Ave., Coalinga, California (Fresno County). A hydrogen refueling station at this location will serve as a connector between

Northern and Southern California for at least the next 10 years. FirstElement Fuel, Inc. accomplished this goal through the steps outlined below.

The site owner and managers at Harris Ranch were always excited to bring a clean, alternative fuel to their station. But they understandably had questions concerning the safety of hydrogen through the first quarter of 2015, and a team effort from FirstElement, automakers, Air Products, and the Governor's Office helped ease the concerns. Lease terms were negotiated, and FirstElement Fuel and Harris Ranch executed a lease on April 23, 2015.

FirstElement Fuel developed the site configuration and design, and Black & Veatch performed the detailed engineering design. The zoning process in Coalinga was particularly straightforward, and approval was granted December 4, 2014, just one month after the application was submitted without the need for a public hearing.

Permits for zoning, building, mechanical, electrical, plumbing, and fire were finalized June 26, 2015. The Fresno County jurisdiction that governs Coalinga assigned the mechanical, electrical, and plumbing permit to a third-party reviewer. Despite Fresno County fire approval, the third-party reviewer commented extensively on issues related to the National Fire Protection Association rules on hydrogen fueling installations. FirstElement worked extensively to educate the reviewer on the application of the fire code and to demonstrate the safety of the proposed station.

FirstElement purchased hydrogen refueling station equipment from Air Products and Chemicals, and the remainder of materials were sourced from a variety of general and specialty vendors. Aliantel from Murrieta, California, was selected as the contractor for the project because of its relatively low bid, excellent safety record, good standing with Black & Veatch, and willingness to work with FirstElement on multiple projects.

Construction began June 8, 2015, and was completed December 11, 2015. The construction phase of the project took longer than anticipated due to a variety of reasons, including that it was Aliantel's first hydrogen station project and the location in Coalinga was difficult to reach quickly.

The process of making the station operational began on August 26, 2015, and was complete on October 9, 2015. The FirstElement team performed the bulk of the tasks including cleaning, purging, and pressure testing. Some delay occurred due to a firm holding back information about the software. After resolution and installation of functioning software, the station was made operational and performed very well in automaker testing.

The Coalinga hydrogen station can dispense 180 kilograms per day. Assuming that FCEVs average 52 miles per kilogram, and consumption of 180 kilograms per day for the next 10 years, the station will offset 8,384 metric tons of total greenhouse gases compared to equivalent gasoline vehicles. Data on the operation of the station will be collected and reported to the Energy Commission throughout the term of operations and maintenance grant ARV-15-034. Data collected and reported will include throughput, vehicle usage, gallons of gasoline displaced, and a comparison of the actual performance of the project to proposed expectations.

CHAPTER 1:
Station Design and Construction

Project Timeline

There were many steps required to bring the Coalinga hydrogen refueling station project to completion. This section highlights the most critical items, provides detail on each, and states the timing required for each step for this particular project.

Site Acquisition (Fall 2013 – April 23, 2015)

From fall 2013 through April 2015, FirstElement Fuel, Inc. (FE) took steps to identify and acquire an appropriate site for the station. FE worked with historical vehicle sales data, academic publications, automakers, and the station location areas in Program Opportunity Notice (PON)-13-607 to select desired market locations. FE then analyzed specific properties within the target locations to find sites that could meet the space requirements for hydrogen fueling equipment.

FE executed a letter of intent was with the Harris Ranch property owner on January 31, 2014. A binding 10-year lease was later executed on April 23, 2015.

Site Design and Engineering (August 12, 2014 – February 13, 2015)

FE and Black & Veatch surveyed the site to begin the site layout on August 12, 2014. They generated initial engineering drawings on September 19, 2014. These drawings are referred to as "CD30s" because they represent 30 percent complete construction drawings and contain only two pages.

Figure 1 shows the equipment compound drawing from the CD30 drawing set. As shown, the drawing lacks specific detail and serves only to outline the site plan.

On October 17, 2014, Clark Survey performed a detailed engineering survey for the Harris Ranch station site, by as shown in Figure 2.

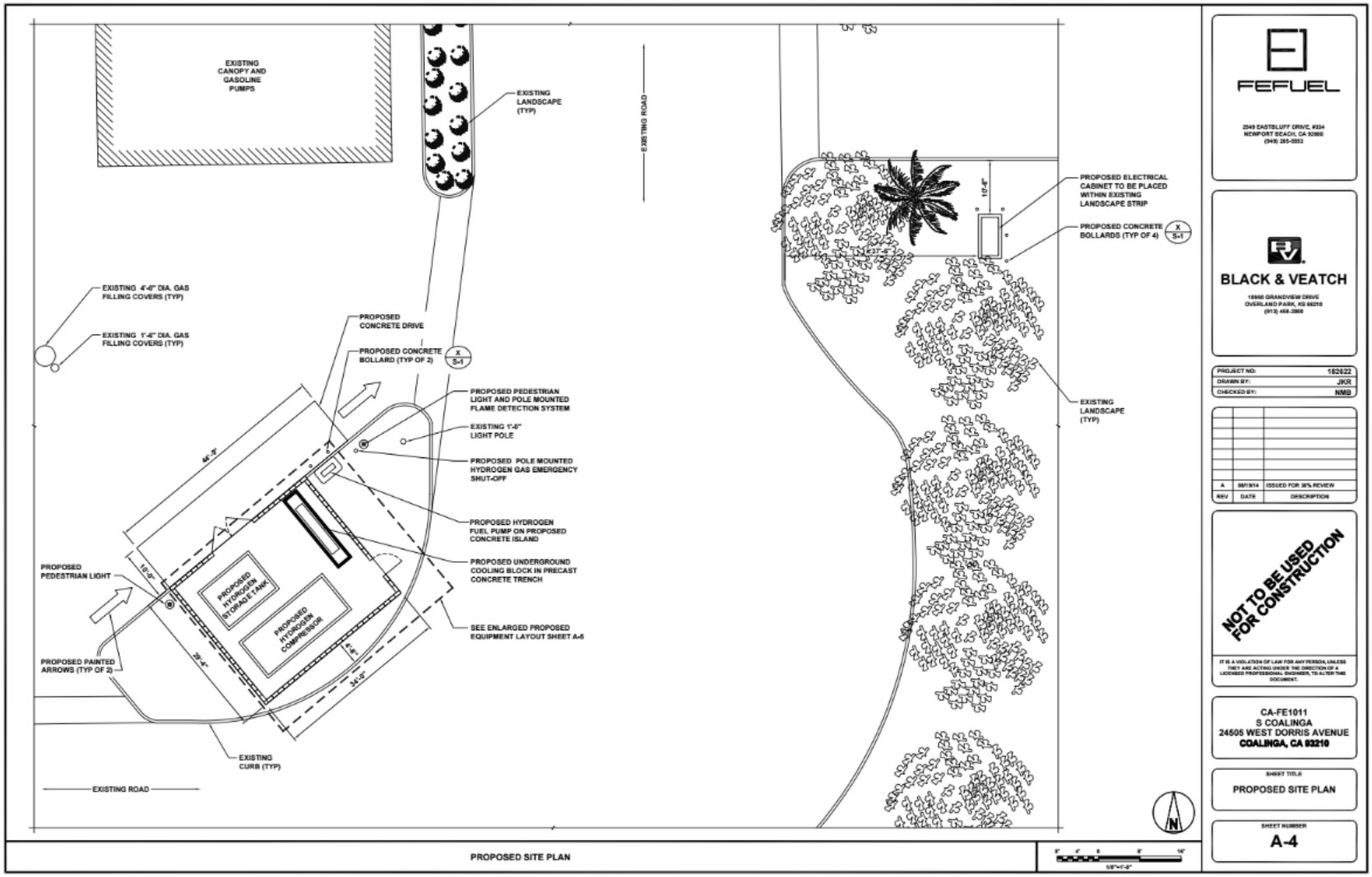
On November 3, 2014, zoning drawings were also generated that provide an accurate but relatively high-level depiction of the project for review by planners at the jurisdiction. These drawings are signed and sealed by the professional engineer of record to ensure accuracy and completeness. The equipment compound page of the zoning drawings is shown in Figure 3.

On February 9, 2015, draft final construction drawings (or "CD90s") were completed that depict all the details required for both construction and the permit review. Four days later, the final construction drawings (or "CD100s") were completed, with 60 pages that depict all the minute details required for both construction and the permit review. These drawings are similarly signed and sealed by the professional engineer of record to ensure accuracy and completeness. The equipment compound page of the CD100 drawings is shown in Figure 4.

Equipment Procurement (September 16, 2014 – July 22, 2015)

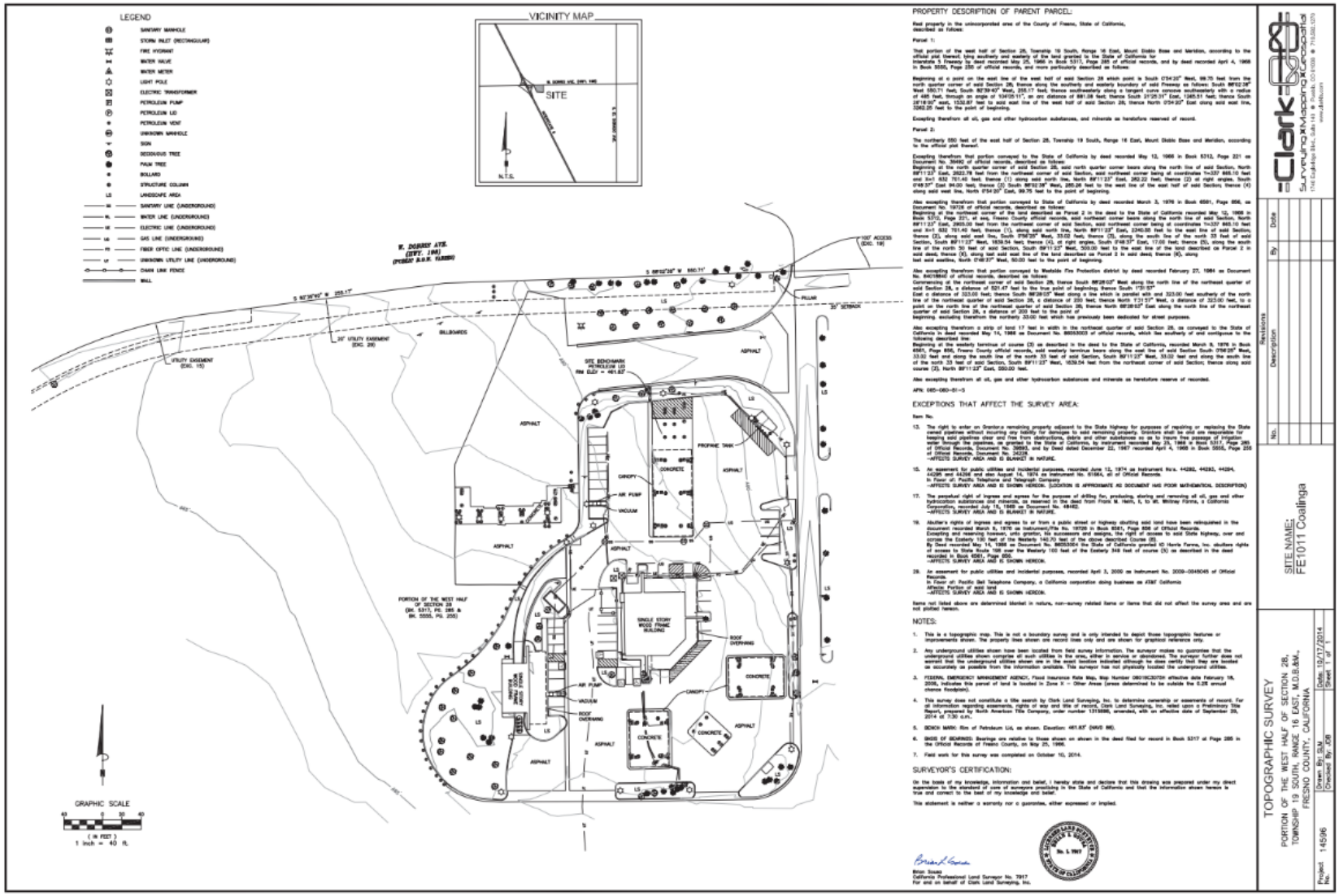
FirstElement selected Air Products equipment because of the cost, capacity, reliability, and more mature supply chain as compared to other suppliers as detail in the FirstElement application for funding under PON-13-607. FE executed a contract was with Air Products for the equipment on September 16, 2014, and equipment was delivered to the site on July 22, 2015.

Figure 1: Relatively Coarse Detail of Equipment Compound From CD30 Drawing



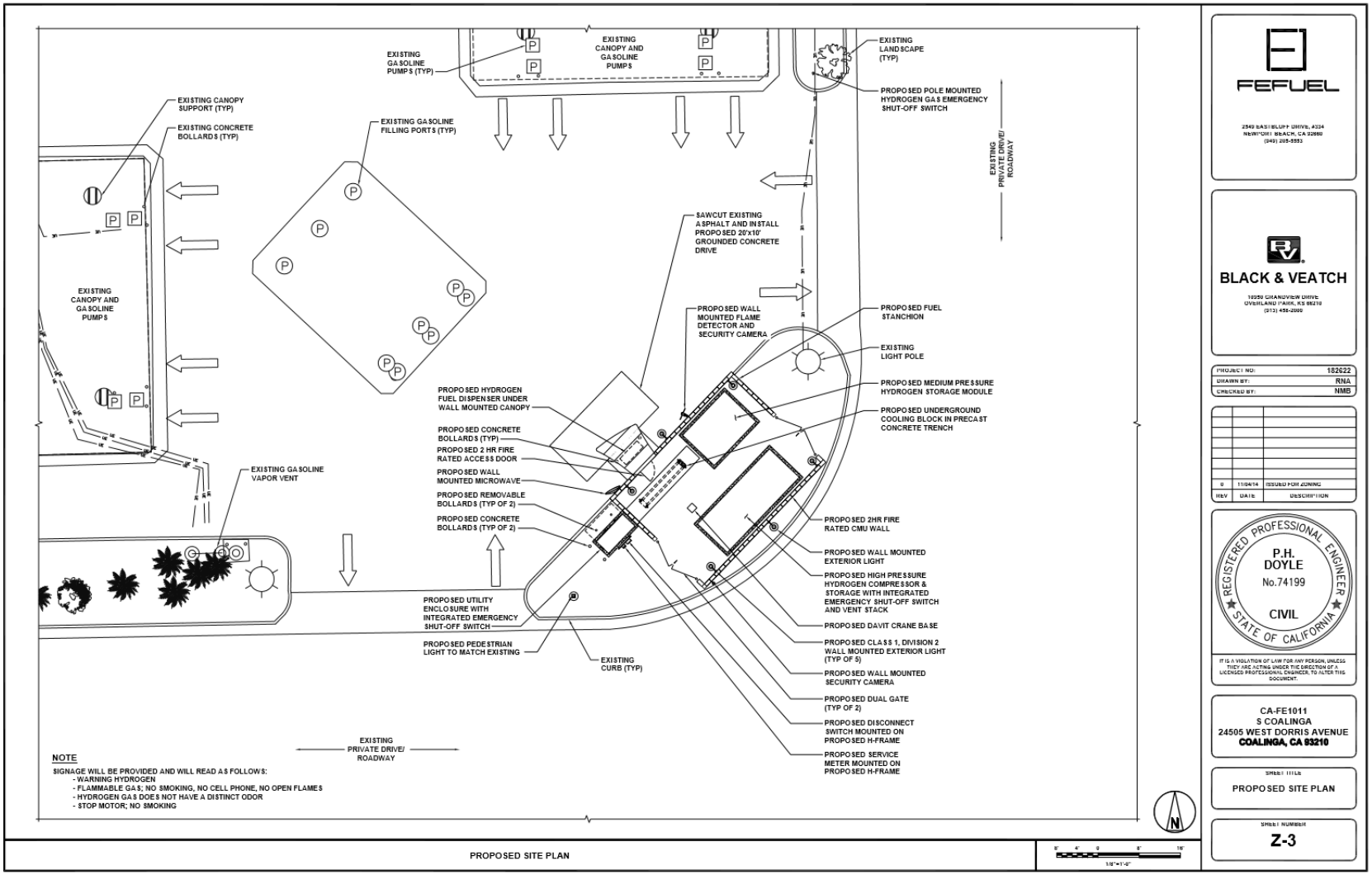
Source: FirstElement Fuel, Inc. Original figure is higher resolution.

Figure 2: Survey of Coalinga Hydrogen Station Location



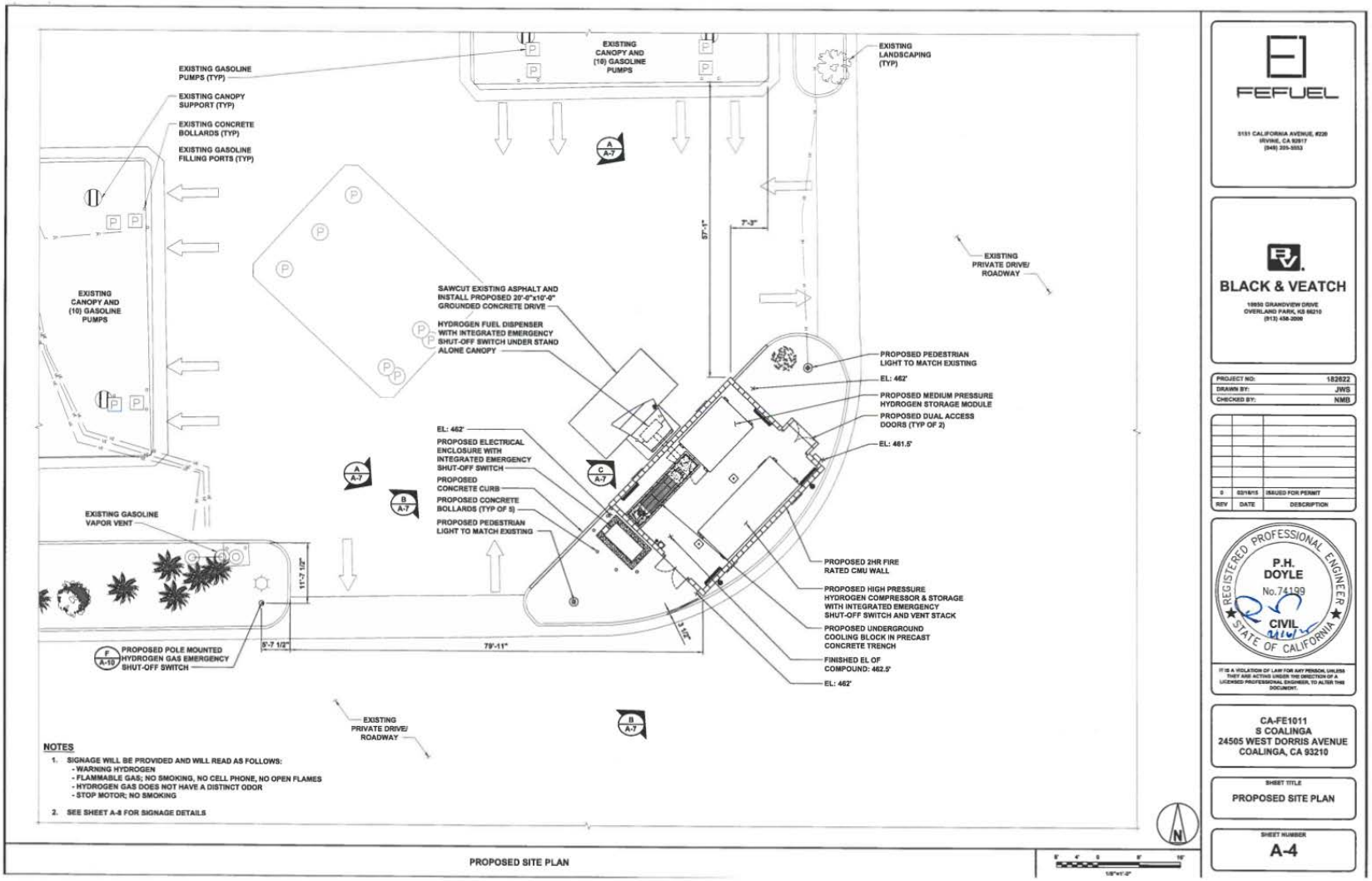
Source: FirstElement Fuel, Inc. Original figure is higher resolution.

Figure 3: Detail of Equipment Compound From Zoning Drawing Set Showing More Detail and Accuracy Than CD30



Source: FirstElement Fuel, Inc. Original figure is higher resolution.

Figure 4: Detail of Equipment Compound From CD100 Drawing Set Showing Complete Detail for Permitting and Construction



Source: FirstElement Fuel, Inc. Original figure is higher resolution.

Entitlement Process (November 4, 2014 – December 4, 2014)

FE and Black &Veatch submitted the zoning application to the jurisdiction having authority on November 4, 2014. The local planning department verified that the project meets the zoning requirements of the location and approved aesthetic, landscaping, and other details that are important to the community. Approval was received through an administrative review process on December 4, 2014, with no public hearing.

Permit Process (February 17, 2015 – June 9, 2015)

All building permit applications were submitted on February 17, 2015, and approved on June 9, 2015.

Construction Process (May 21, 2015 – September 30, 2015)

FE and Black & Veatch submitted a detailed bid package to nearly 20 contractors on May 21, 2015. The contract was awarded to Aliantel on May 26, 2015. The bulk of Aliantel's construction experience lies in cell phone towers. Aliantel provided a reasonable bid, had a desire to get involved with hydrogen projects, and had a willingness to work in Coalinga. Construction started June 8, 2015, with hydrogen storage, compression, cooling, and dispensing equipment delivered to the site July 22, 2015, as shown in Figure 5. Construction was completed September 30, 2015.

Figure 5: Crane Beginning to Lift Hydrogen Compressor Skid off Delivery Truck in Coalinga

Source: FirstElement Fuel, Inc.

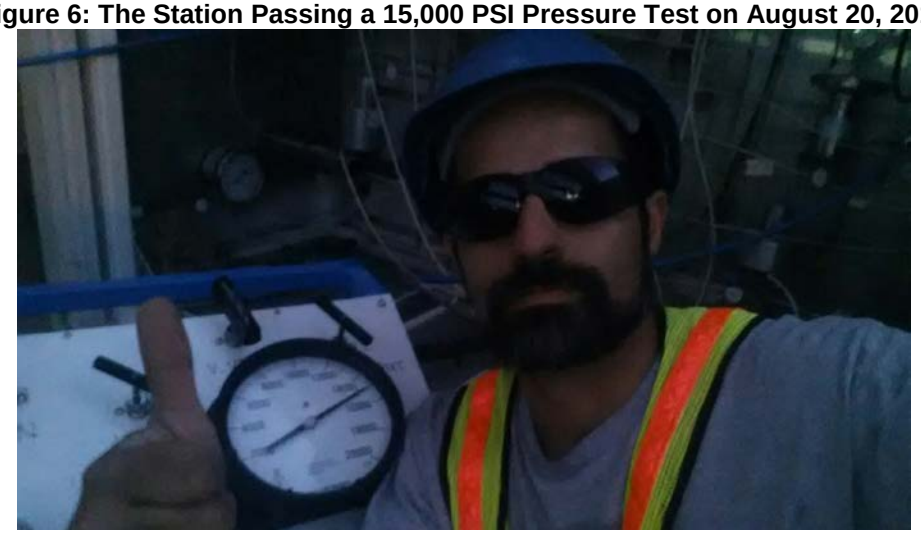
Making the Station Operational (August 10, 2015 – September 18, 2015)

The cleaning and purging of lines, pressure testing, and hydrogen sampling to make the station operational are shown in Figure 6, Figure 7, and Figure 8.

Station Declared Operational (October 9, 2015)

The Coalinga hydrogen station met the definition of operational in PON-13-607 by completing installation of all station/dispenser components, obtaining all the required permits from the local jurisdiction, successfully passing a hydrogen quality test, successfully fueling one fuel cell vehicle with hydrogen, and opening to the public.

Figure 6: The Station Passing a 15,000 PSI Pressure Test on August 20, 2015



Source: FirstElement Fuel, Inc.

Figure 7: First Hydrogen Delivery to the Coalinga Station September 1, 2015

Source: FirstElement Fuel, Inc.

Figure 8: Hydrogen Fuel Quality Report on September 1, 2015

www.SmartChemistry.com

SAE J2719 Report

FIRST ELEMENT

COALINGA H70 H_2

@Nozzle sampled on 9/1/2015

	SAE J2719 Limits (µmol/mol)	Smart Chemistry Detection Limits (µmol/mol)	Concentration (µmol/mol)	Analytical Method
Water	5	0.2	**0.27**	ASTM D7649
Total Hydrocarbons (C_1 Basis)	2	1	**0.087**	ASTM D7892
Methane		0.001	0.019	
Acetone			0.045	
Ethanol			0.014	
Isopropyl Alcohol			0.0093	
Oxygen	5	1	< 1	ASTM D7649
Helium	300	10	< 10	ASTM D1946
Nitrogen, Argon	100			
Nitrogen		5	< 5	ASTM D7649
Argon		0.5	< 0.5	ASTM D7649
Carbon Dioxide	2	0.5	< 0.5	ASTM D7649
Carbon Monoxide	0.2	0.0005	**0.0028**	ASTM D5466
Total Sulfur	0.004	0.000001	**0.000015**	ASTM D7652
Hydrogen Sulfide		0.000002	0.0000052	ASTM D7652
Carbonyl Sulfide		0.000001	0.000010	ASTM D7652
Methyl Mercaptan (MTM)		0.000008	< 0.00001	ASTM D7652
Ethyl Mercaptan (ETM)		0.00002	< 0.00002	ASTM D7652
Dimethyl Sulfide (DMS)		0.00002	< 0.00002	ASTM D7652
Carbon Disulfide		0.00001	< 0.00001	ASTM D7652
Isopropyl Mercaptan (IPM)		0.00002	< 0.00002	ASTM D7652
Tert-Butyl Mercaptan (TBM)		0.00002	< 0.00002	ASTM D7652
n-Propyl Mercaptan		0.00002	< 0.00002	ASTM D7652
n-Butyl Mercaptan		0.00002	< 0.00002	ASTM D7652
Tetrahydrothiophene (THT)		0.00002	< 0.00002	ASTM D7652
Formaldehyde	0.01	0.001	< 0.001	ASTM D7892
Formic Acid	0.2	0.015	< 0.015	ASTM D5466
Ammonia	0.1	0.01	< 0.01	ASTM D5466
Total halogenates	0.05		< 0.01	
Chlorine		0.001	< 0.001	ASTM D5466
Hydrogen Chloride		0.007	< 0.007	ASTM D5466
Hydrogen Bromide		0.007	< 0.007	ASTM D5466
Organic Halides (32 compounds in red and bold listed in "Other Hydrocarbons"). Smart Chemistry limit is for each individual organic halide.		0.001	< 0.001	ASTM D7892
Particulate Concentration (Particulate Concentration Calculation Sheet is listed in Table II)	1mg/Kg		**0.075 mg/kg**	ASTM D7651
Particulates Found & Size (Images of particulates found is in Table 1)			**Only one 0.06 mm particulate**	ASTM D7634
Hydrogen Fuel Index The hydrogen fuel index is the value obtained when the amount of aggregate impurities, as, expressed as percent (µmole/µmole), is subtracted from 100%. (Section 3.5 of SAE J2719)			**99.99996%**	

SMART CHEMISTRY, 3401 La Grande Blvd, Sacramento, CA 95823, (916)391-3300, jphsu@smartchemistry.com

Source: FirstElement Fuel, Inc. Original figure is higher resolution.

Automaker testing was performed at the Coalinga hydrogen station to verify correct operation per SAE J2601. Figure 9 shows Mercedes F-Cell and Toyota Mirai fuel cell vehicles staged for testing.

Figure 9: Toyota and Mercedes Automaker Testing at Coalinga Station on October 13, 2015

Source: FirstElement Fuel, Inc.

DMS Certification (October 19, 2015 – October 21, 2015)

The California Department of Food and Agriculture's Division of Measurement Standards (DMS) is responsible for enforcing California weights and measures laws and regulations and must certify any device used for metering the sale of commercial items within California. The temporary DMS approval was received for the Coalinga hydrogen station on October 21, 2015, as shown in Figure 10. The permanent DMS approval was received on May 4, 2016.

Figure 10: Temporary DMS Certification at Coalinga Hydrogen Station

Source: FirstElement Fuel, Inc.

Customer Usage (October 9, 2015 – Present)

The first public customer filled a Hyundai Tucson at the Coalinga station on October 9, 2015, and the station has been used regularly since then. In part due to excitement about a new station, and in part due to a customer appreciation event organized by Mercedes-Benz (Figure 11), the Coalinga station dispensed 110 kilograms (kg) of hydrogen in October 2015. Sales in December 2015 were 32 kg and 45 kg in January 2016.

Figure 11: News Article About Mercedes' F-Cell Customers Traversing California Using the Coalinga Hydrogen Station on October 18, 2015

AUTOMOBILES & MORE

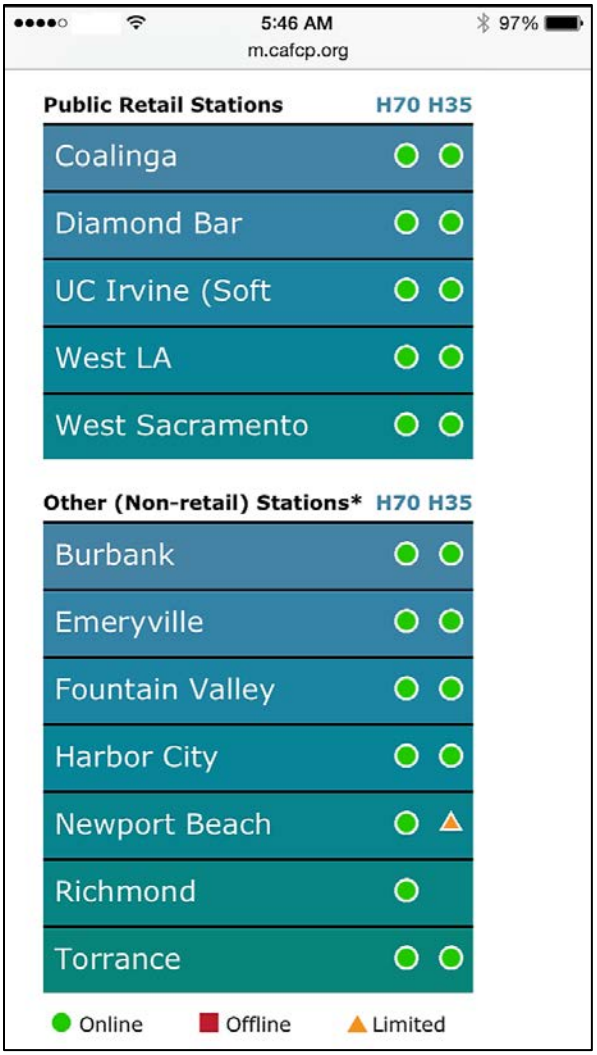
First H2 Trip Between Los Angeles and San Francisco

Source: FirstElement Fuel, Inc.

SOSS Activated (December 14, 2015)

The California Fuel Cell Partnership (CaFCP) Station Online Status System (SOSS) provides regularly updated station status information to fuel cell vehicle drivers. FE developed software that provides the required updates to the SOSS system. The software development took longer than anticipated, but the Coalinga hydrogen station began sending regular status updates on fuel availability at 700 bar and 350 bar to SOSS on December 14, 2015, as shown in Figure 12.

Figure 12: Screenshot of CaFCP SOSS Showing Coalinga Hydrogen Station Status



Source: FirstElement Fuel, Inc.

The station is open and active.

Figure 13: Hyundai Tucson FCEV Filling at Coalinga Hydrogen Station

Source: FirstElement Fuel, Inc.

Environmental Impacts

Hydrogen is stored as a compressed gas in an above-ground tank concealed behind a wall at this station. Hydrogen is nontoxic, colorless, and odorless, so hydrogen station equipment is outfitted with appropriate sensors to provide immediate notification in case a leak occurs. No solid or liquid waste will be produced at this site.

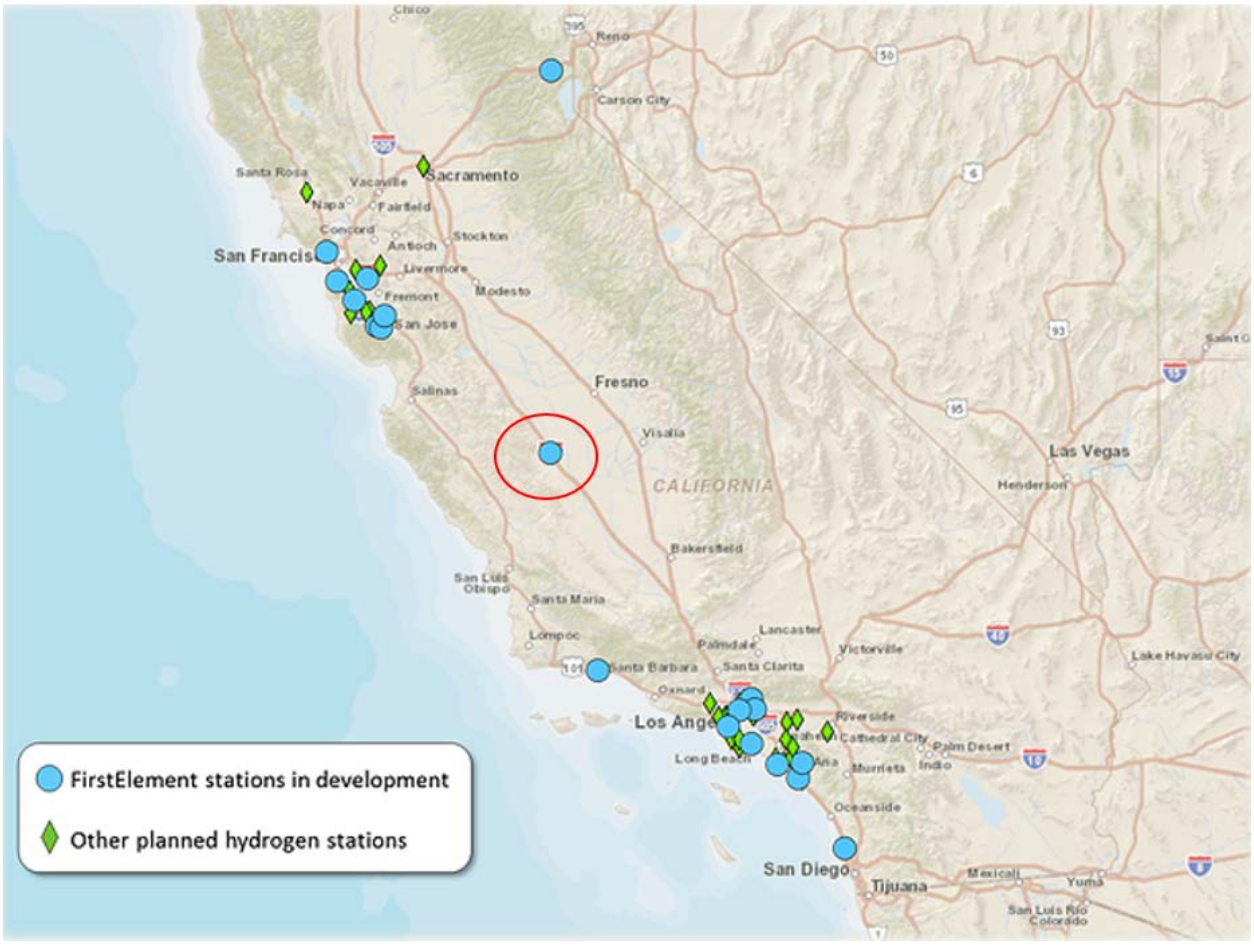
Three mature palm trees were removed from the site and relocated. There was no additional landscaping added for the construction of the hydrogen refueling station, and, therefore, no additional irrigation water will be consumed.

The use will not cause any unsightly appearances, such as noise, glare, dust, or odor. The facility is a modern addition to the existing gasoline station. No outdoor sound amplification systems were installed; however, lighting was installed at the facility to ease evening fueling.

Coalinga Station in the Network

Figure 14 shows the location of the Coalinga hydrogen station at 24505 West Dorris Avenue as the connecting link for fuel cell drivers between Northern and Southern California.

Figure 14: The Coalinga Hydrogen Station Links Northern and Southern California

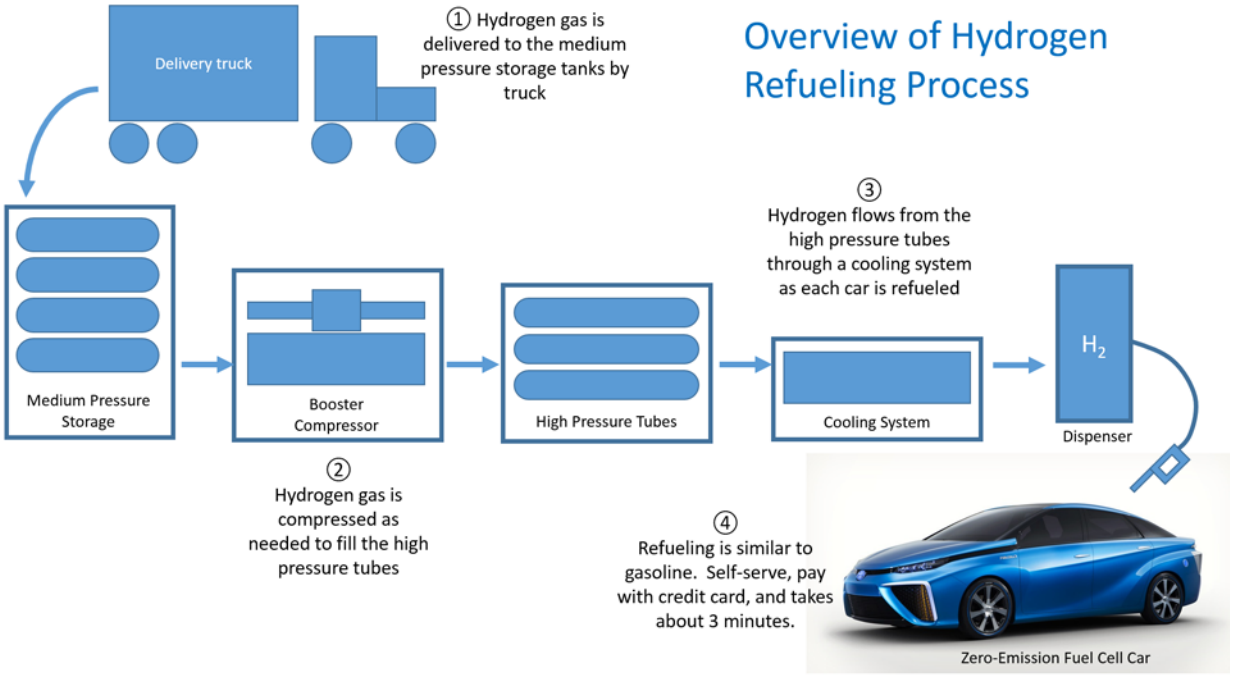


Source: FirstElement Fuel, Inc.

Schematic Layout of the Coalinga Station

As shown below, Figure 15 depicts an overview of the Coalinga hydrogen station components and the steps in the refueling process.

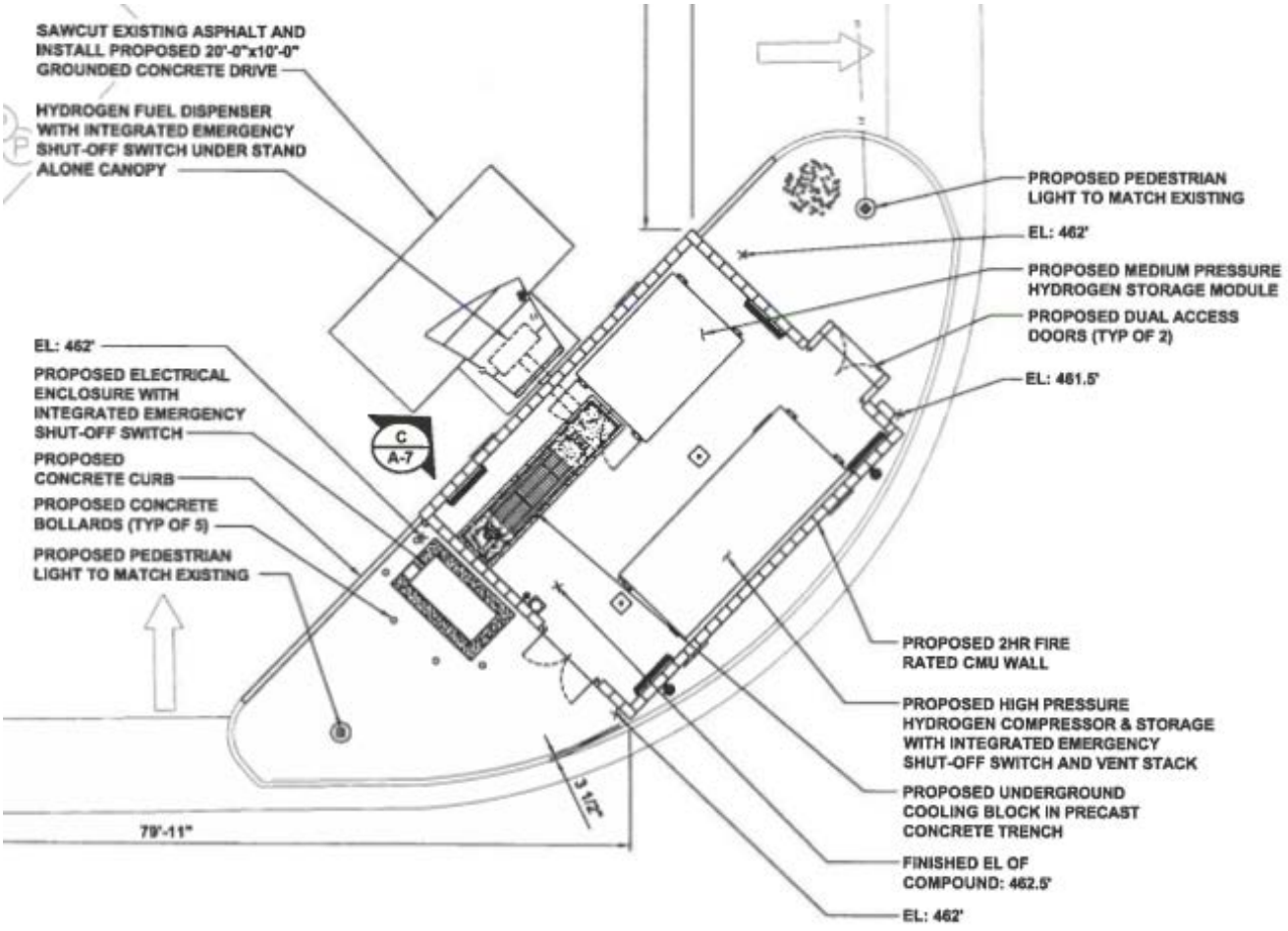
Figure 15: Schematic Depicting Hydrogen Station Equipment and Refueling Process



Source: FirstElement Fuel, Inc.

Figure 16 shows a detailed view of the actual final, as-built configuration of the Coalinga station.

Figure 16: Enlarged View of Final Coalinga Layout



Source: FirstElement Fuel, Inc. Original is higher resolution.

List of Subcontractors and Budget

Air Products and Chemicals, Inc., Allentown, PA	
H_2 station equipment	$1,480,192.21
Black & Veatch, Overland Park, KS	
Construction	$455,984.02
Engineering	$55,884.40
Permitting	$31,307.47
Project Management	$18,197.53
Various Vendors	
Construction Materials (tubing, wire, etc.)	$33,568.68
Fixtures (doors, lights, etc.)	$62,937.48
MSI Tech, Irvine CA	
Data Collection Tool	$3,432.87
Karen Calhoun, Newport Beach, CA	
Legal services	$13,150.03
Vertical Advisors LLP, Newport Beach, CA	
Financial services	$4,345.13
Total Vendor Costs	$2,158,999.82
California Energy Commission Grant	$1,451,000.00
Remaining cash provided by FE	$707,999.82
Total Energy Commission cost share (w/o FE internal costs)	67.2%

CHAPTER 2:
Data Collection and Energy Analysis

The Coalinga hydrogen refueling station is supplied by hydrogen generated via steam methane reformation (SMR) that converts methane (CH_4) and water (H_2O) to hydrogen (H_2) and carbon dioxide (CO_2):

$$CH_4 + 2H_2O \rightarrow 4H_2 + CO_2$$

Per California Senate Bill 1505 (Lowenthal, Chapter 877, Statutes of 2006) and PON-13-607, which funded this project, at least one-third of the hydrogen dispensed will be produced from renewable energy sources.

Hydrogen is supplied to the proposed hydrogen fueling stations from Air Products' hydrogen production facilities in Wilmington/Carson, California. Renewable biogas will be procured as feedstock for the facilities, resulting in delivered hydrogen product that meets the 33 percent renewable requirements. Renewable hydrogen at 100 percent is achievable through the same supply pathway, however at a higher cost.

Air Products has a contract for sourcing the renewable biogas that meets Public Resources Code Section 2574(b)(1); documentation is provided in Figure 17. Although California has a substantial amount of biogas, local supply cannot be injected into California pipelines under California Health and Safety Cost Section 25420. Air Products' biogas supply for this project is sourced outside California and transported to California with connection to a natural gas pipeline within the Western Electricity Coordinating Council (WECC) region that delivers gas into California.

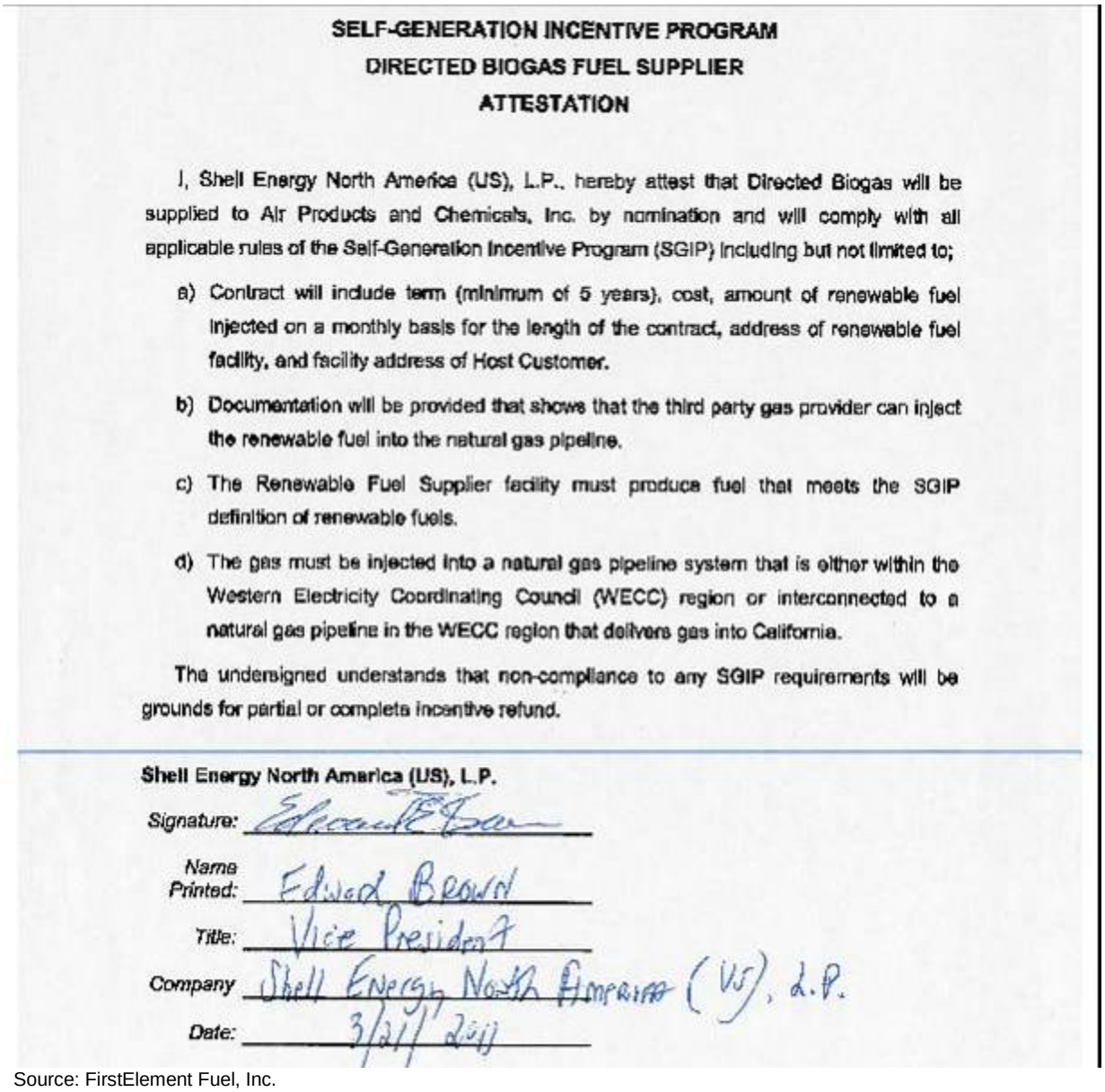
Figure 17: Documentation of Biogas Sources

Exhibit A
RB Supply Sources
Shell Energy North America (US), L.P.

Supply Source	Address	Pipeline/LDC	Receipt	Delivery
Greentree Landfill	635 Toby Road Kersey, PA 15846	National Fuels Gas TETCO NGPL EPNG Socal Gas FAR	Landfill meter Nat Fuel-Bristoria Tetco-Sweet Lake 3825 EPNG Jal 3083 Topock	Bristoria NGPL-Sweet Lake EPNG Jal 3083 Topock Socal Citygate
Imperial Landfill	11 Boggs Road Imperial, PA 15126	National Fuels Gas TETCO NGPL EPNG Socal Gas FAR	Landfill meter Nat Fuel-Bristoria Tetco-Sweet Lake 3825 EPNG Jal 3083 Topock	Bristoria NGPL-Sweet Lake EPNG Jal 3083 Topock Socal Citygate

Source: FirstElement Fuel, Inc.

Figure 18: Biogas Supply Contract Between APCI and Shell Energy North America



SELF-GENERATION INCENTIVE PROGRAM
DIRECTED BIOGAS FUEL SUPPLIER
ATTESTATION

I, Shell Energy North America (US), L.P., hereby attest that Directed Biogas will be supplied to Air Products and Chemicals, Inc. by nomination and will comply with all applicable rules of the Self-Generation Incentive Program (SGIP) including but not limited to;

a) Contract will include term (minimum of 5 years), cost, amount of renewable fuel injected on a monthly basis for the length of the contract, address of renewable fuel facility, and facility address of Host Customer.

b) Documentation will be provided that shows that the third party gas provider can inject the renewable fuel into the natural gas pipeline.

c) The Renewable Fuel Supplier facility must produce fuel that meets the SGIP definition of renewable fuels.

d) The gas must be injected into a natural gas pipeline system that is either within the Western Electricity Coordinating Council (WECC) region or interconnected to a natural gas pipeline in the WECC region that delivers gas into California.

The undersigned understands that non-compliance to any SGIP requirements will be grounds for partial or complete incentive refund.

Shell Energy North America (US), L.P.

Signature: Edward E Beard

Name Printed: Edward Beard

Title: Vice President

Company Shell Energy North America (US), L.P.

Date: 3/21/2011

Source: FirstElement Fuel, Inc.

Hydrogen is delivered to the Coalinga hydrogen refueling station by a Department of Transportation-certified high-pressure delivery trailer.

The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model (GREET) produced by Argonne National Laboratory was used to determine the energy sources and greenhouse gas emissions data presented in Table 1. As shown, one-third of the energy feedstock is renewable, nearly zero petroleum is used, and the only tailpipe emissions are water. Also, the entire well-to-wheels greenhouse gas emissions are 58 percent lower than similar usage for a typical gasoline vehicle.

Table 1: Energy Sources and Well-to-Wheel Greenhouse Gas Emissions for FE Hydrogen Compared to Average California Gasoline

Energy Sources	Fuel Cell Vehicle Fueled at FirstElement Station	Average California Internal Combustion Car Fueled by Gasoline
Coal	1.7%	0.4%
Petroleum	0.3%	78.6%
Natural Gas	64.7%	13.9%
Renewable	33.3%	7.1%
Total GHGs	178 grams/mile	428 grams/mile
Tailpipe Emissions	pure water	VOC, CO, NO_x, PM10, PM2.5, SOx, CH_4, N_2O, and toxins

Source: FirstElement Fuel, Inc.

The Coalinga hydrogen station can dispense 180 kg/day. Assuming that FCEVs average 52 mile/kg (taken from GREET) and consumption of 180 kg/day for the next 10 years, the station will offset 8,384 metric tons of total GHGs compared to equivalent gasoline vehicles. Furthermore, the Coalinga hydrogen station will eliminate more than 1.54 million gallons of gasoline, assuming the 2013 national passenger fleet average fuel economy of 21.6 mpg[1].

Data on the operation of the station will be collected and reported to the Energy Commission throughout the term of the grant. Data collected and reported will include throughput, vehicle usage, gallons of gasoline displaced, and a comparison of the actual performance of the project to proposed expectations.

1 Department of Transportation, Bureau of Transportation Statistics; Table 4-23: Average Fuel Efficiency of U.S. Light Duty Vehicles; http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_04_23.html.

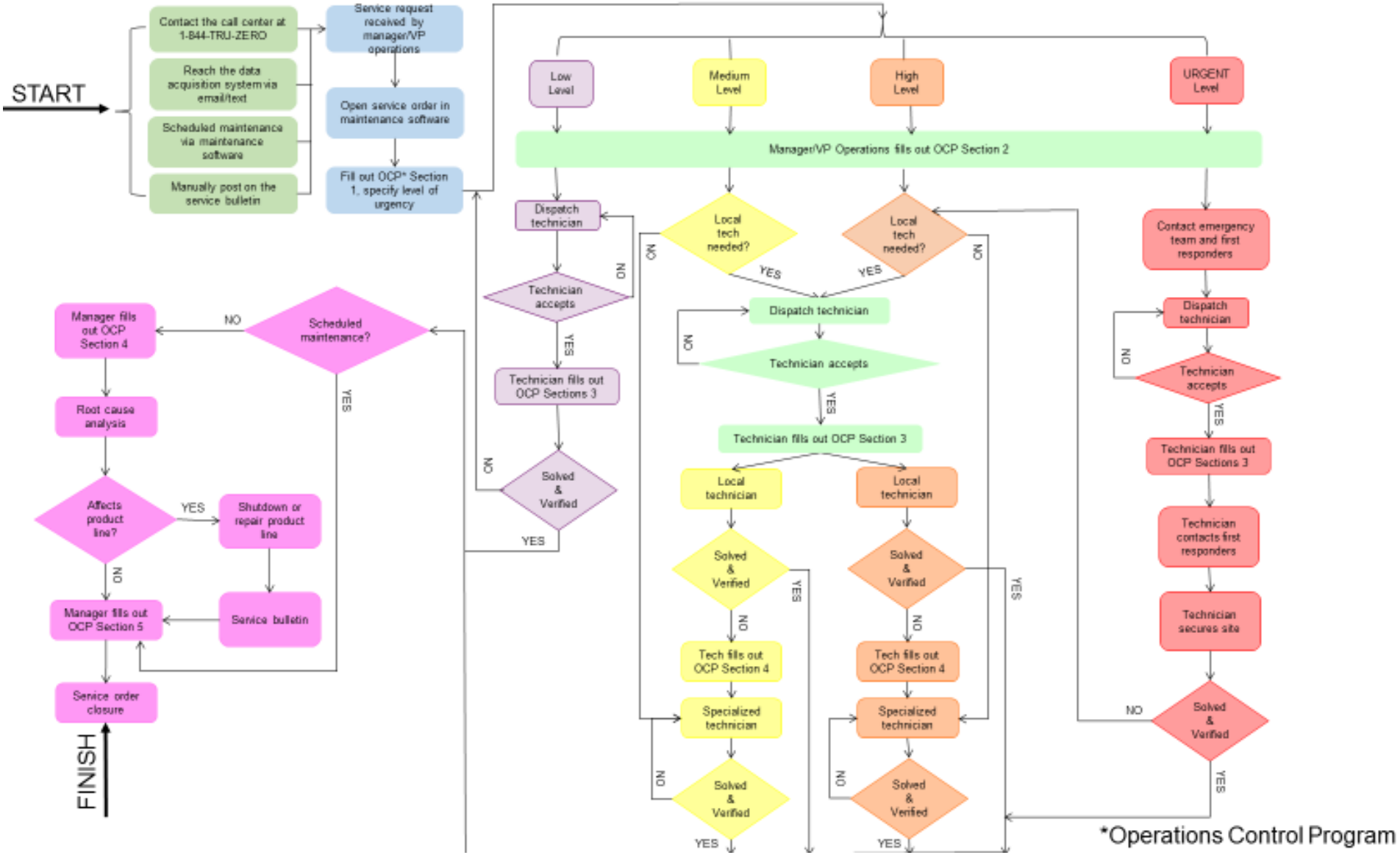
CHAPTER 3:
Statement of Future Intent

FE intends to own and operate the Coalinga refueling station for at least 10 years. FE has invested substantial capital to build the station and will require many years of operation to recoup the development costs. FE has executed an initial 10-year lease with the landowner and has the possibility for up to 10 additional years of lease extension.

In addition, FE is building an in-house maintenance team that will have the personnel and equipment resources to maintain and repair any of its stations as quickly as possible throughout California.

Figure 19 shows a flow diagram for response from the operations and maintenance team.

Figure 19: FE Operations and Maintenance Control Plan



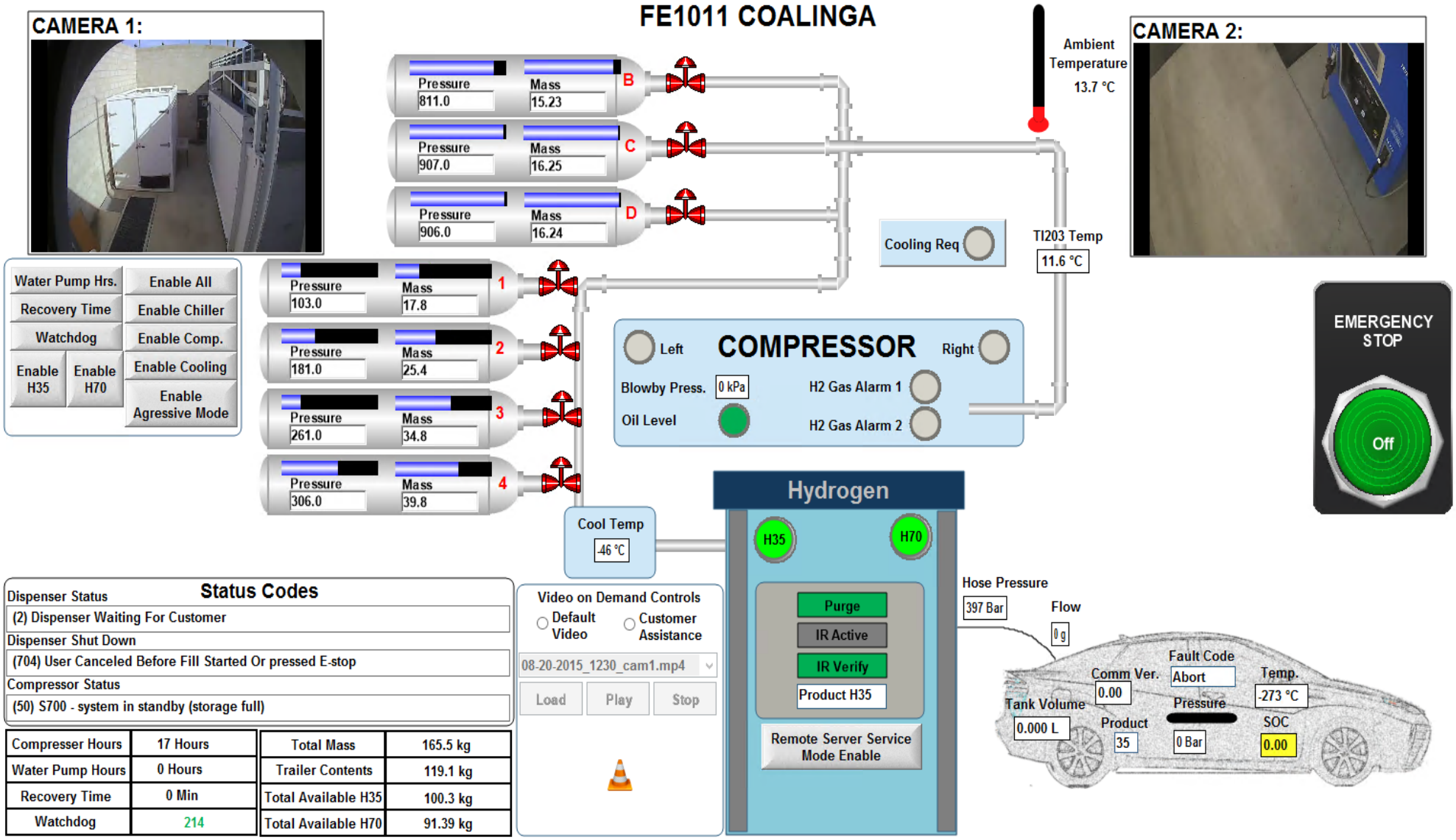
Source: FirstElement Fuel, Inc.

The Coalinga station poses particular challenges since it is 3-4 hours away from the bulk of FE stations in the Los Angeles and San Francisco regions. Because it will be difficult for an FE employee to reach Coalinga quickly, two additional levels of operations support will be employed for this location. First, several Harris Ranch general maintenance personnel will be trained and available to handle minor problems that may require things such as simple reset switches or software reboots. Second, a local contractor will be on-call to handle more substantial repairs.

To augment onsite personnel across the FE network, a comprehensive data collection and monitoring system has been implemented. Figure 20 shows a screenshot of one page of the system. FE maintenance personal can access a breadth of real-time performance and sensor data, live video feeds, and historical usage data and can control some features of the station remotely, 24 hours a day.

In addition to remote monitoring, FE has implemented rigorous computerized maintenance management systems and enterprise asset management systems to schedule and track maintenance, repairs, and inventory. These facilitate work order generation, logging for all maintenance and repair activities, help maximize station up-time, and enable tracking of key performance indicators.

Figure 20: Screenshot of FE's Remote Monitoring System



Source: FirstElement Fuel, Inc.

CHAPTER 4:
Findings, Conclusions, and Recommendations

The following is a list of important findings from the Coalinga hydrogen station project:

- Despite the location of the equipment at the project site being more than 100 feet from other structures and many miles from large urban areas, safety was still a major consideration that had to be addressed thoroughly with the land owner and local jurisdictions.
    - Being unfamiliar with hydrogen, the land owner had many safety concerns that were addressed through a special, in-person workshop held onsite that included FirstElement, several automakers, Air Products, and state representatives.
- As is the case with many jurisdictions, Fresno County outsourced its building plan review to a third-party consultant. This particular consultant raised many hydrogen safety concerns that were not necessarily supported by applicable fire code.
- National Fire Protection Association – Hydrogen Technologies Code (NFPA 2) is a critical tool for working with permit agencies. The code clearly defines fire safety guidelines that enable local jurisdictions and builders to reach common ground while ensuring safety via the rigorous NFPA code writing process. The key is for both station builders and station permit agencies to fully understand, and appreciate, the content of NFPA 2.

Acronyms

Alternative and Renewable Fuels and Vehicle Technology Program (ARFVTP)

California Energy Commission (Energy Commission)

California Fuel Cell Partnership (CaFCP)

Construction Drawing (CD)

Division of Measurement Standards (DMS)

FirstElement Fuel, Inc. (FE)

Fuel cell electric vehicle (FCEV)

Greenhouse gas (GHG)

Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model (GREET)

Kilograms (kg)

National Fire Protection Association – Hydrogen Technologies Code (NFPA 2)

Program opportunity notice (PON)

Steam methane reformation (SMR)

Station online status system (SOSS)

Western Electricity Coordinating Council (WECC)

Zero emission vehicle (ZEV)